

ENTRY AND EXIT OF SYRINGOPHILID MITES
(ACARINA: SYRINGOPHILIDAE) FROM THE LUMEN
OF THE QUILL

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Several species of mites are known to inhabit the quills of bird feathers (Wehr, 1952; Radford, 1953; Kethley, 1970). Obviously entry and exit from the quill must be either through the superior umbilicus or through specially constructed openings, but no adequate descriptions exist of the methods utilized. Whether the superior umbilicus remains open, allowing free access, or closes during formation of the quill is not clarified in the literature. Although feather development has been extensively studied (Lillie, 1940; Lucas and Stettenheim, 1972), the "umbilical plug" which seals the superior umbilicus has not been well described.

The quill mite, *Syringophiloidus minor* (Berlese) is a common parasite of the House Sparrow (*Passer domesticus*) and provides an excellent example of how mites have adapted to life within the quill. After the internal pulp has been resorbed, the mites feed by piercing the quill wall with their styletiform chelicerae (Kethley, 1971). Adult female mites emerge from mature quills and disperse to enter developing feathers. Transfer of mites from the feathers of parent birds to the developing feathers of nestlings presumably occurs during diurnal brooding or nest roosting. During molt the mites disperse from the old quills into the developing feathers of the new plumage (Kethley, 1971; Casto, 1973; 1974). In this report, I describe those aspects of feather development and structure which affect entry and exit of *S. minor* from the quill.

MATERIALS AND METHODS

From January 1971 through July 1972, 492 House Sparrows ranging in age from nestling to adult were collected in the vicinity of Lubbock, Texas. Examination for mites consisted of plucking the primaries, major primary coverts, secondaries, major secondary coverts, alulars, and rectrices, followed by opening the quill of each feather to determine infestation. Mites were recovered from the exsheathed feathers of nestlings and the developing feathers of molting birds by peeling away that portion of the sheath which lies proximal to the unfurled vanes.

As the external pulp of the primaries, secondaries, and rectrices is resorbed and the vanes exsheath, the superior umbilicus generally becomes closed by a structure which I have designated as the umbilical plug. The plug consists of the dried pulp membrane, the degenerating axial artery, and incompletely resorbed blood and mucus. The normal appearance of the plug is that of a tiny blood clot. Virtually all of the larger feathers have a plug, even though it may consist of only the dried, transparent pulp membrane. Observations on the formation of the umbilical plug and its role in regulating entry of

mites into the quill lumen were made from those developing feathers of nestlings, fledglings, and molting birds which were in the last stages of exsheathment and resorption of the external pulp.

The structure of the umbilical plug in mature quills was demonstrated from freehand sections. Sections were photographed and the negative projected with an enlarger. The outline was traced and compared with the original in order to draw in details.

Twenty molting House Sparrows were kept under laboratory observation for several weeks in an attempt to determine if mite infestations produce feather loss, feather picking, or irritable behavior. At the end of the observation period the birds were sacrificed and examined to determine the extent of infestation.

RESULTS AND DISCUSSION

Eighty-two percent (402) of the 492 House Sparrows examined were infested. The primaries, major primary coverts, secondaries, and rectrices were the most commonly infested feathers. An average of 13 feathers (range = 1 to 42) was infested per bird. The youngest bird infested was a nestling estimated by the degree of feather exsheathment (Weaver, 1942) to be 11 days old.

The mites exhibit a preference for different feathers and feather tracts in the juvenal and first nuptial plumages. These preferences appear to be due to certain developmental features of the juvenal feathers and the sequence with which the feathers of this plumage are replaced during the postjuvenal molt (Casto, MS).

Entry Into the Developing Feathers.—Female mites enter the superior umbilicus of developing feathers after the protective sheath has split from the pinfeather. That portion of the sheath immediately proximal to the unfurled vanes appears as an opaque white region (Lucas and Stettenheim, 1972) and serves to retard water loss from the pulp apex (Lillie, 1940). This portion of the sheath also serves to protect from exposure those mites which have entered the superior umbilicus of a developing feather.

Upon entry into the umbilicus of a developing feather, mites move proximally 2–5 mm until they reach the apex of the pulp. The anterior ends of the mites point proximally and lie near the pulp apex, suggesting that the pulp is the food source. As many as six mites have been recovered from a single feather.

Mites in developing feathers are found laterally appressed to the rachis at the point where the vanes are attached. In this position the mites lie between the two layers formed by the rachis with its attached vanes and the pulp membrane. As the external pulp is resorbed and the vanes exsheath the mites move proximally along the rachis, always maintaining their position between the two layers.

Occurrence of the Umbilical Plug.—Umbilical plugs are frequent features

TABLE 1
OCCURRENCE OF UMBILICAL PLUGS IN THE REPLACEMENT FEATHERS
OF MOLTING HOUSE SPARROWS

Feather tract	Number examined	Plug present (percent)	Plug absent (percent)
Primaries	269	221 (82)	48 (18)
Secondaries	227	202 (89)	25 (11)
Rectrices	184	153 (83)	31 (17)
Total	680	576 (85)	104 (15)

in the remiges and rectrices of the House Sparrow (Table 1) and also occur in the major primary coverts. Contrary to the observation of Kethley (1971), the umbilici of the primary coverts of adult sparrows do not always remain open allowing free access to the quill lumen. Of 216 juvenal primary coverts examined, 78 (36 percent) had plugs. Plugs in the primary coverts are not seated as firmly as those in the larger feathers.

Movement of Mites Through the Umbilicus.—Female mites enter the passageway of the superior umbilicus at the time of plug formation. The strand of material composing the plug in its early formation is soft and can be pushed to one side as the mite moves into the passageway. Movement through the passageway is hazardous, and mites often become ensnared in exudates of the degenerating pulp. When a hardened plug is removed from a mature feather and closely examined, it is often found to contain the remains of a mite. Occasionally two and sometimes three dead invaders are found in the umbilicus.

Structure of the Umbilical Plug.—The structure of an umbilical plug from primary number 5 is shown in Fig. 1. The passageway in which the plug is seated is a continuation of the ventral groove of the rachis. The cortical layer of the groove continues proximally as the dorsal lining of the umbilical passageway. The dorsal lining of the passageway becomes thinner as it nears the lumen of the quill.

The proximal end of the umbilical plug is continuous with the pulp membrane which forms the first internal pulp cap. The wedge shape of the hardened plug insures that mites attempting entry would only seat the plug more firmly into the umbilicus. Exit of mites from the lumen is by destruction of the fragile strand which connects the first internal pulp cap with the plug. The plug may then be displaced distally into the ventral groove.

Exit Channels.—If the plug cannot be displaced, the mites construct an exit channel by cutting through the thin cortex and soft medullary tissue (pith)

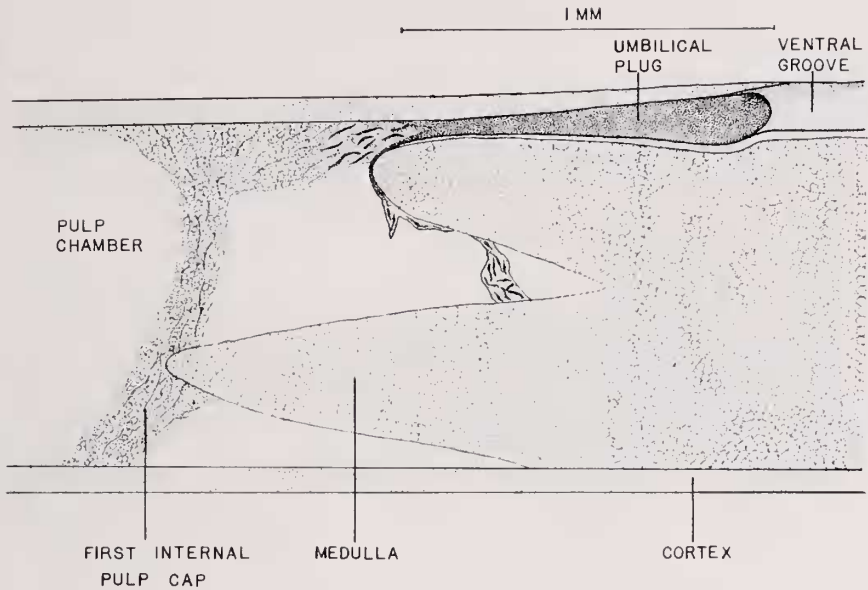


FIG. 1. Umbilical plug of primary number 5 (lateral section)

in the dorsal region of the passageway (Fig. 2). Construction of the exit channel is at an oblique angle to the ventral groove and leaves the plug intact. On several occasions two exit channels, one on each side of the plug, were observed. The means by which the mites produce the exit channel is not known. I have found no evidence that *S. minor* constructs any type of hole or channel for entry into the quill.

Kethley (1969) collected representatives of five genera of syringophilids from quills which had a small hole immediately distal to the superior umbilicus. When the infested quills were isolated in small tubes the mites were observed to leave the quills via these holes. I have also found these holes in the quills of Brown-headed Cowbirds (*Molothrus ater*) infested by syringophilids. These holes are probably produced by mites which move from the quill lumen into the cavity of the rachis and then burrow ventrally through the pith and cortical layer of the ventral groove.

The Effects of Infestation of Syringophilid Mites.—Several authors (Rebrassier and Martin, 1932; Schwage, 1956; Hwang, 1959) have noted the loss of plumage which occurs when domestic chickens are infested by *Syringophilus bipectinatus*. Critsenko (1973) believed that the feeding of *S. bipectinatus* produced an itching which caused chickens to pick at infested feathers. Feather loss was thought to result from a relaxation of muscle tonus.

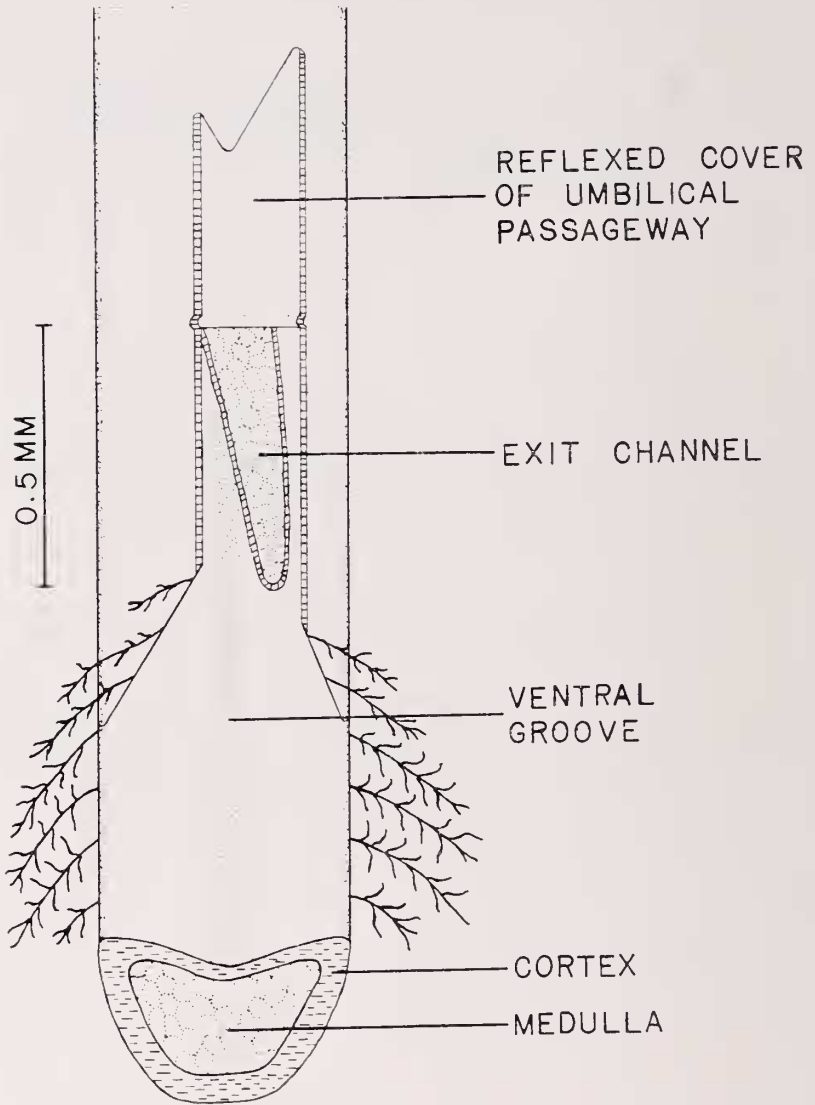


FIG. 2. Exit channel produced by the quill mite, *Syringophiloidus minor*.

thereby allowing the developing feather germ to push the old, infested feather from its follicle. A decrease in productivity was also noted during infestation by *S. bipectinatus*. Wehr (1952) has reported feather loss and feather picking when developing feathers of the House Canary are infested by the dermoglyphid mite, *Dermoglyphus elongatus*.

I found no evidence of feather loss in House Sparrows infested by *S. minor*. The exit channels and the many small holes which are produced in the quill wall by the feeding activities of the mites do not appear to structurally weaken the feather. Although several of the sparrows kept under observation were infested, they did not pick at their feathers or show any indication that they were irritated by the mites.

SUMMARY

Eighty-two percent (402) of 492 House Sparrows collected in the vicinity of Lubbock, Texas, were infested by the quill mite, *Syringophiloides minor* (Berlese). An average of 13 feathers (range = 1-42) was infested per bird. The youngest bird infested was estimated to be 11 days old. Dispersing female mites enter the superior umbilicus of developing feathers. Entry into the lumen of the quill is regulated by formation of a plug which seals the superior umbilicus during feather development. Once seated in the umbilical passageway, the wedge-shaped plug prevents further entry of mites. Exit from the lumen of the quill is accomplished by displacement of the plug into the ventral groove or by specially constructed exit channels. The exit channels and the small holes which are produced in the quill wall by the feeding activities of the mites do not appear to structurally weaken the feather.

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